

WHAT IS CLAIMED IS:

1. A plasma processing apparatus comprising:
 - a vacuum chamber that accommodates an object
 - 5 to be processed, and provides a plasma process to the object in a vacuum or reduced pressure environment;
 - a dielectric for transmitting microwaves to said vacuum chamber and for maintaining the vacuum or reduced environment of the vacuum chamber;
 - 10 a plate that has slots for guiding the microwaves to the dielectric; and
 - a temperature control mechanism that has a cooling channel between said plate and said dielectric, and controls temperature of the dielectric.
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2. A plasma processing apparatus according to claim 1, wherein an interval between said plate that forms the cooling channel and said dielectric is equal to or smaller than 2 mm.
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3. A plasma processing apparatus according to claim 1, wherein the cooling channel is supplied with coolant.
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4. A plasma processing apparatus according to claim 3, wherein the coolant includes at least one of

air, nitrogen, inactive gas, Fluorinert®, Galden® and
fluorine included solution.

5 5. A plasma processing apparatus according to
claim 3, wherein the coolant includes gas, liquid or a
low dielectric loss material.

10 6. A plasma processing apparatus according to
claim 1, wherein the cooling channel is exhaustibly
supplied with coolant.

15 7. A plasma processing apparatus according to
claim 1, further comprising:
 a temperature detector for measuring the
temperature of or near said dielectric; and
 a controller for controlling a flow rate of
coolant based on the temperature detected by said
temperature detector, the coolant being supplied to the
cooling channel.

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8. A plasma processing apparatus according to
claim 1, wherein the cooling channel arranges a heat
conductive medium.

25 9. A plasma processing apparatus according to
claim 8, wherein the heat conductive medium is arranged
around said dielectric.

10. A plasma processing apparatus according to claim 8, wherein the heat conductive medium includes silicon powder or silicon oil.

5 11. A plasma processing apparatus according to claim 8, wherein the heat conductive medium is a high dielectric loss material.

10 12. A plasma processing apparatus according to claim 1, wherein said plate is made of a material that includes at least one of aluminum, gold, silver and copper.

15 13. A plasma processing apparatus according to claim 1, wherein said dielectric is made of a material that includes at least one of alumina-ceramic, aluminum nitride and quarts.

20 14. A plasma processing apparatus according to claim 3, further comprising:

a waveguide for guiding the microwaves to the plate, said waveguide forming plural holes in place which allow the coolant to pass through the holes and prevent the microwaves from transmitting through the
25 holes; and

a partition, formed on said waveguide between the place of said waveguide and a microwave source for

supplying the microwaves, for preventing the coolant from moving along said waveguide to the microwave source.

- 5 15. A plasma processing apparatus according to claim 3, wherein said partition is made of a high dielectric loss material.

- 10 16. A plasma process method for plasma-processing an object to be processed which is accommodated in a vacuum chamber in a vacuum or reduced pressure environment, said method comprising the steps of:

 detecting temperature near a dielectric that maintains the vacuum or reduced pressure environment of
15 the vacuum chamber as well as transmitting microwaves to the vacuum chamber; and

 controlling a flow rate of coolant in a cooling channel arranged between the dielectric and a plate having slots that guide the microwaves into the
20 dielectric, based on a detection result by said detecting step.